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A new genus from Madagascar with strongly enlarged labium (Ephemeroptera, Baetidae)

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Abstract

A new genus of Baetidae, *Megalabiops* **gen. nov.**, and a new species, *M. madagasikara* **sp. nov.**, are described from Madagascar based on nymphs. The new genus is characterized by having a strongly enlarged mentum; pedicelli with many long, stout, pointed setae; a brush of dense, short setae between prostheca and mola of both mandibles; an apically pointed maxillary palp with a stout seta at the tip; and a labium with many long, simple setae ventrally on glossae. The patellotibial suture is absent on the fore tibia and present on middle and hind tibiae. The claw is strongly elongated with two rows of denticles. The imago remains unknown and the relationships with other African genera of Baetidae are tentative. Despite being easily identifiable, only two nymphs were found in two highly sampled localities in Madagascar.

Keywords

Afrotropical, mayflies, morphology, Protopatellata, systematics

Introduction

With nearly one third of all mayfly species worldwide (ca. 1,100 species in 114 genera), the family Baetidae has the highest species diversity among mayflies (updated from Sartori and Brittain 2015; Jacobus et al. 2019). Their distribution is cosmopolitan, excluding only Antarctica, New Zealand, and New Caledonia. Investigations of the molecular phylogeny of the order Ephemeroptera revealed the relatively basal position

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of the family in Ephemeroptera phylogeny (Ogden and Whiting 2005; Ogden et al. 2009, 2019). The generic diversity of Baetidae is the highest in the Afrotropical realm (ca. 41 genera), followed by the Neotropical (ca. 27 genera), the Oriental (ca. 26 genera), the Nearctic (20 genera), the Palaearctic (17 genera) and finally the Australasian (ca. 12 genera) realms (updated from Gattolliat and Nieto 2009; Kluge 2021).

Madagascar is the fourth-largest island in the world with ca. 581,500 km^2, situated ca. 400 km east of Africa in the Indian Ocean. Some 160 million years ago, the supercontinent Gondwana started to break apart and the eastern section of this land mass, incl. today's Madagascar, drifted eastwards. Approximately 140 million years ago, the landmass composed of Madagascar and the Indian subcontinent was completely separated from the African landmass, without subsequent land connection. Finally, around 80 million years ago, Madagascar split from the Indian subcontinent and stayed isolated until today. This long-term isolation in combination with a high topographic and geological complexity, supporting speciation on the island, is responsible for the outstanding biological richness and the high level of endemism in Madagascar (Goodman 2009).

Until 1990, the Malagasy mayflies, as other aquatic insects, remained very poorly known. Only a few reports were made based on a limited number of specimens and localities (Navás 1930, 1935; Demoulin 1955, 1966a, b, 1968, 1973). In 1993, a program led by the French ORSTOM and the Malagasy CNRE began a large survey of the freshwater macroinvertebrates, sampling specimens in 650 localities. The specimens collected during this study allowed to report or describe about one hundred species of mayflies from Madagascar (Elouard et al. 2003). Mayflies were also collected by Edmunds and collaborators in the early 1970's, but only studied more than 20 years later (Lugo-Ortiz and McCafferty, 1997a, b, c, 1998a, c, d, 1999; Lugo-Ortiz et al. 1999). Baetidae are the most diversified family of mayflies in Madagascar. They encompass 24 genera and 56 species, with more than 95% of the species described after 1997. The family can be considered relatively well known at the generic level, but the revision of a part of the most diversified genera is still pending. Madagascar exhibits a high degree of endemism as all the species of Baetidae (except *Cloeon smaeleni* Lestage, 1924) and one third of the genera are limited to this island (Gattolliat and Sartori 2003). Except for the three widely distributed genera *Cloeon* Leach, 1815, *Labiobaetis* Novikova & Kluge, 1987 and *Nigrobaetis* Kazlauskas (in Novikova and Kluge), 1987, all other genera have a distribution limited to the Afrotropical region, with multiple transoceanic dispersal events between Madagascar and the African continent (Monaghan et al. 2005; Gattolliat et al. 2008).

The present study is based on two nymphs collected in 2001 and 2003 in two different locations in Madagascar. The type-locality was sampled fourteen times during biodiversity assessments of Malagasy streams between 1993 and 2003 by teams of the French ORSTOM (Office de la recherche scientifique et technique outre-mer) and the Museum of Zoology, Lausanne (MZL) (Elouard and Gibon 2001) as well as during a survey of this catchment (Oliarinony et al. 2016). However, no further specimens were discovered. The species is immediately recognizable as a new genus by the remarkable enlargement of the labium.

Materials and methods

The specimens were collected in 2001 and 2003 from two different locations in the same area of Madagascar. Specimens were preserved in 70%-80% ethanol. Nymphs were dissected in Cellosolve (2-Ethoxyethanol) with subsequent mounting on slides in Euparal medium, using an Olympus SZX7 stereomicroscope.

The DNA of one specimen was extracted using non-destructive methods allowing subsequent morphological analysis (see Vuataz et al. 2011 for details). We amplified a 658 bp fragment of the mitochondrial gene cytochrome oxidase subunit 1 (COI) using the primers LCO 1490 and HCO 2198 (Folmer et al. 1994, see Kaltenbach and Gattolliat 2020a for details). Sequencing was done with Sanger's method (Sanger et al. 1977).

Drawings were made using an Olympus BX43 microscope. Photographs of nymphs were taken with a Canon EOS 6D camera and processed with Adobe Photoshop Lightroom (https://adobe.com/ch_de/products/photoshop-lightroom) and Helicon Focus version 5.3 (http://www.heliconsoft.com). Photographs were subsequently enhanced with Adobe Photoshop Elements 13 (https://adobe.com/ch_de/products/photoshop).

Distribution maps were generated with SimpleMappr (https://simplemappr.net, Shorthouse 2010).

The terminology used in the manuscript follows Hubbard (1995) and Kluge (2004).

The new species is established based on morphological characters.

Abbreviation

MZL Museum of Zoology Lausanne (Switzerland).

Results

***Megalabiops* gen. nov.**
http://zoobank.org/871DA221-4FDB-4CF6-B81B-88E6C35527AB
Figures 1–7

Type species. *Megalabiops madagasikara* gen. et sp. nov., by present designation.

Diagnosis. Nymph. This new genus is distinguished by the combination of the following characters: A) body rather short and stocky (Fig. 1); B) base of antennae close to each other, with rather broad carina between them (Fig. 2a); C) pedicellus with many long, stout, pointed setae (Fig. 3a); D) labrum rather small, lateral margins straight, distal margin largely V-shaped; dorsal surface with one long, submedian seta and submarginal arc of setae restricted to a few simple setae (Fig. 3b); E) both mandibles with brush of medium, fine setae between prostheca and mola (Fig. 3c, f); F) hypopharynx with large, medial tuft of stout setae (Fig. 4a); G) maxillary palp 2-segmented (Fig. 4b); H) labium with strongly enlarged mentum (Fig. 2b–d); glossae basally broad, narrowing toward apex, shorter than paraglossae; inner ventrolateral

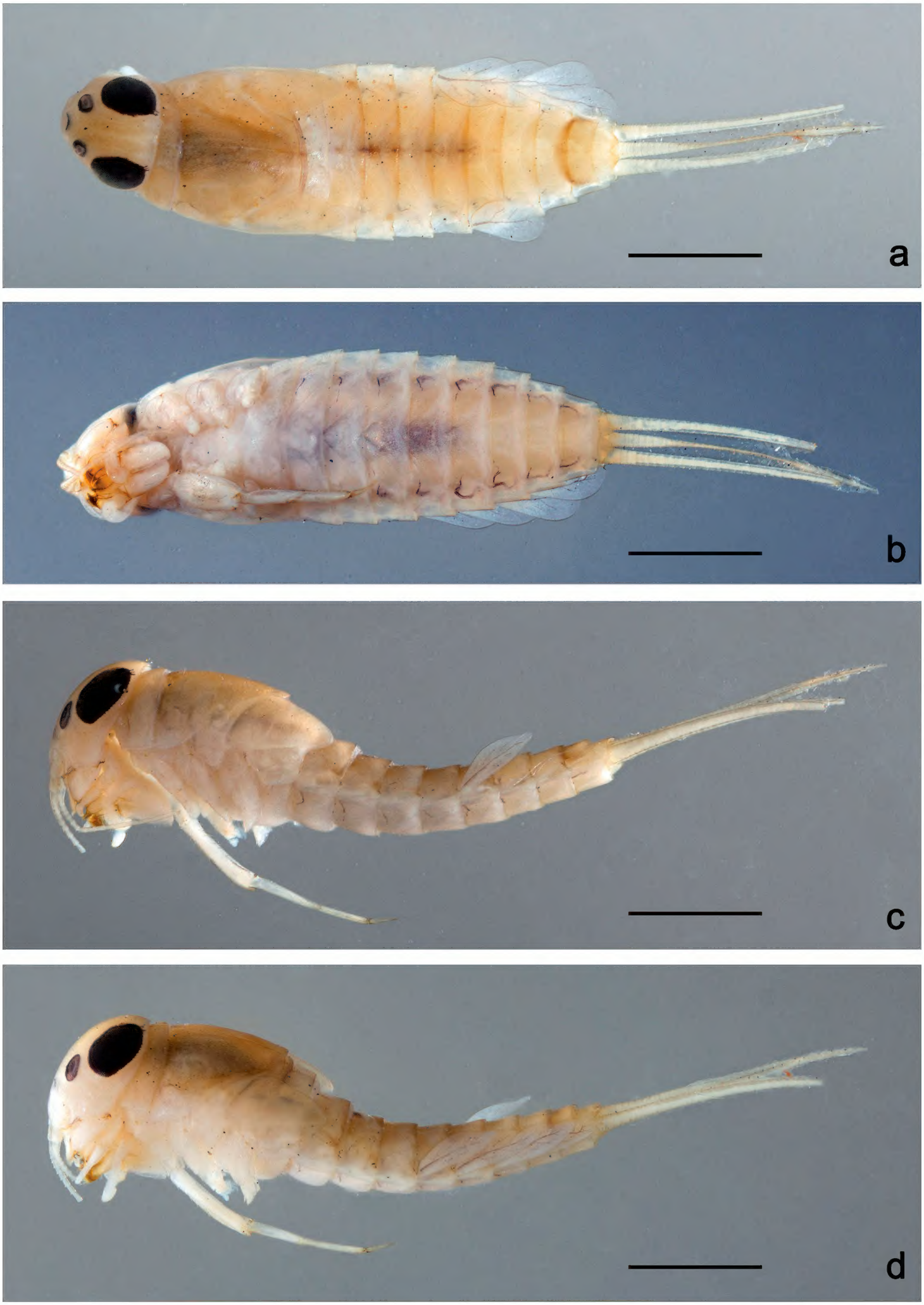

Figure 1. *Megalabiops madagasikara* gen. et sp. nov., habitus, nymph **a** dorsal view **b** ventral view **c,d** lateral view. Scale bars: 1 mm.

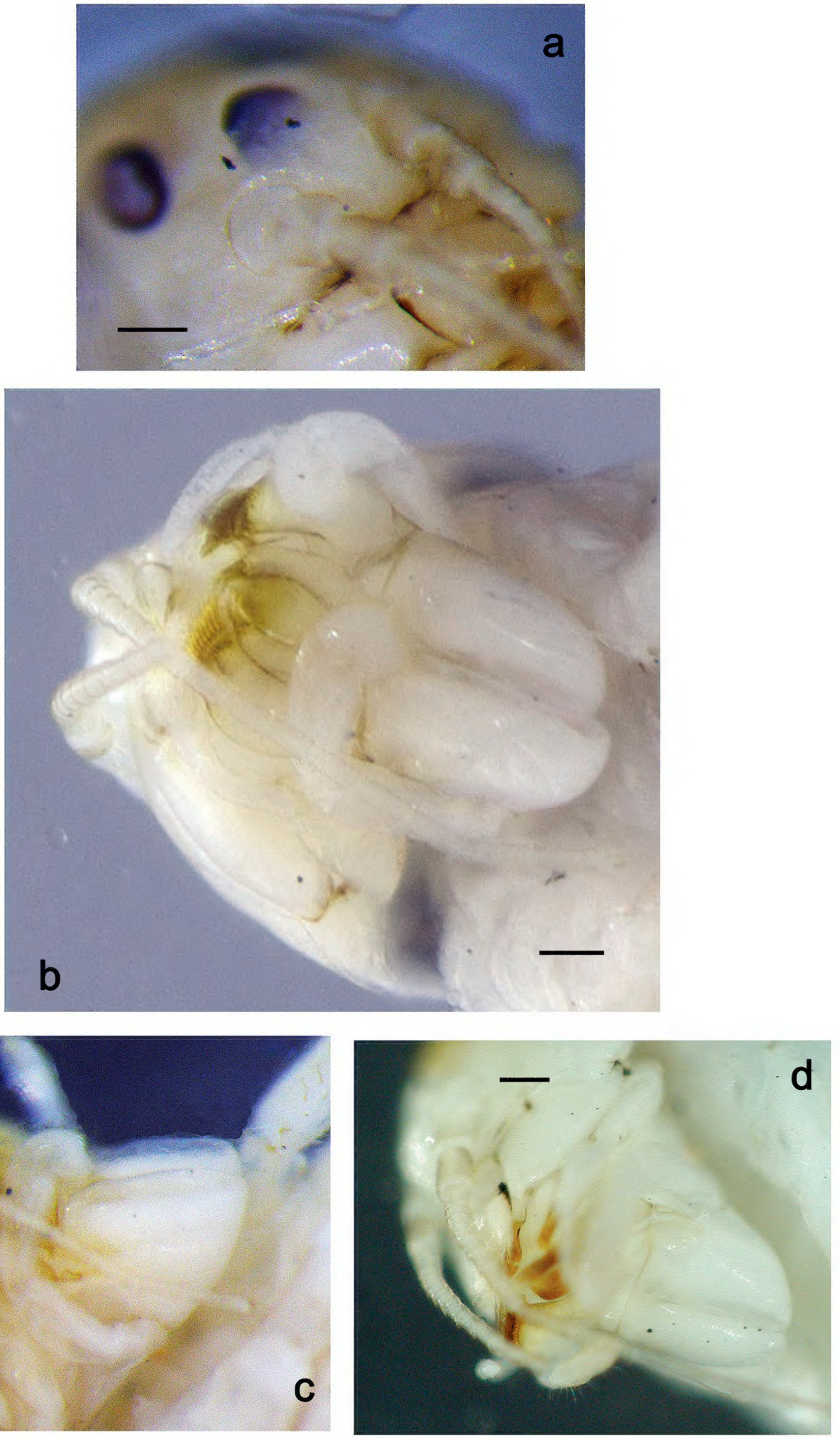

Figure 2. *Megalabiops madagasikara* gen. et sp. nov., nymph morphology **a** frontal section of head **b** head, ventral view **c** labium, lateral view **d** head, ventrolateral view. Scale bars: 0.1 mm.

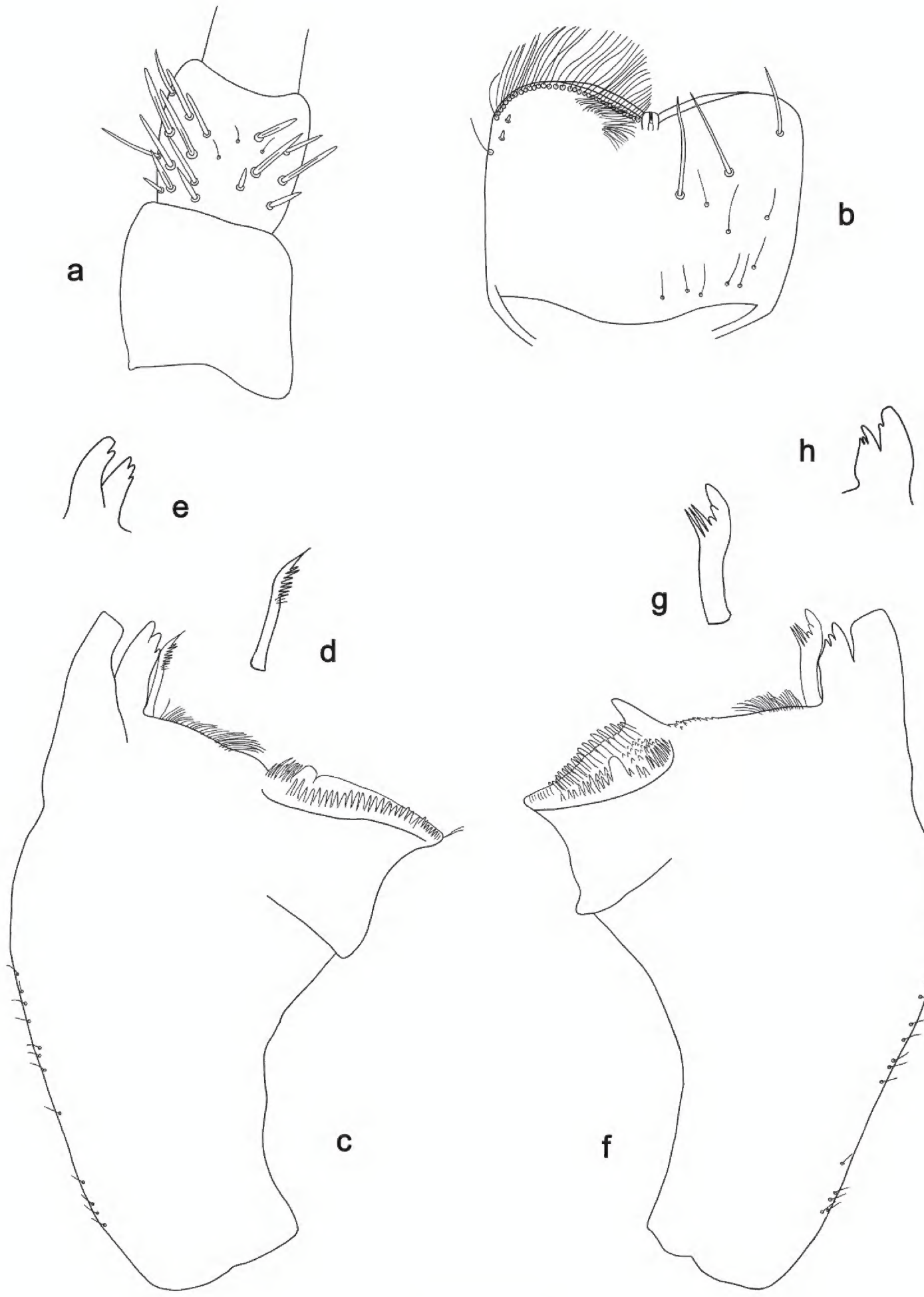

Figure 3. *Megalabiops madagasikara* gen. et sp. nov., nymph morphology **a** base of antenna **b** labrum (left: ventral view, right: dorsal view) **c** right mandible **d** right prostheca **e** right incisor and kinetodontium **f** left mandible **g** left prostheca **h** left incisor and kinetodontium. Scale bars: 0.1 mm.

margin of glossae with a row of long, simple setae, close to ventrolateral margin with a row of very long, simple setae, apically with some very robust, long, curved setae; stout paraglossae, slightly curved inward, apex with three rows of stout, pectinate setae; labial palps segment II without distolateral protuberance, segment III slightly pentagonal (Fig. 4d, e); I) forelegs with a row of long, spine-like setae on dorsal margin of femur; femoral patch absent on all legs; patellotibial suture absent on foreleg and present on middle and hind legs; claw strongly elongated, pointed, with two rows of numerous, minute denticles (Fig. 5a, b); J) posterior margin of abdominal tergites with triangular spines, lateral margins without spines (Fig. 6a).

Imagines. Unknown.

Etymology. *Megalabiops* is an arbitrary combination of letters with allusion to the Greek words *mega* and *iops*, and the Latin word *labium*. *Megalab-* is with reference to the strongly enlarged *labium* and *-iops* with reference to the Baetidae which look and move like small fishes. The gender is feminine.

Description. Nymph. (Figs 1–7).

Body. Short and stocky (Figs 1, 2).

Head. ***Antenna*** (Figs 2a, 3a). Antennae bases close to each other, with broad carina between them. Pedicellus with many long, stout, pointed setae; scapus bare.

Labrum (Fig. 3b). Rather small, lateral margins straight and distal margin largely V-shaped, wider than long; on dorsal surface with one submedian, long, simple seta and submarginal arc of setae restricted to few simple setae; on ventral margin anterolaterally and medially with a row of long, fine setae.

Right mandible (Fig. 3c, d, e). Incisor and kinetodontium cleft, kinetodontium with distinct denticles; inner margin of innermost denticle without a row of thin setae; prostheca stick-like, apicolaterally denticulate; margin between prostheca and mola with brush of abundant, medium, fine setae.

Left mandible (Fig. 3f, g, h). Incisor and kinetodontium partially cleft, kinetodontium with distinct denticles; prostheca robust, apically with denticles and comb-shaped structure; margin between prostheca and mola with brush of abundant, medium, fine setae; mola slightly reduced in size.

Hypopharynx (Fig. 4a). Lingua rather broad and expanded, with large dorsomedial tuft of stout setae.

Maxilla (Fig. 4b, c). Apically with three canines and three denti-setae; distal denti-seta tooth-like, closely attached to canines, following same direction as canines, other denti-setae slender, bifid and pectinate; maxillary palp 2-segmented, apically pointed and with stout seta at the tip.

Labium (Figs 2b–d, 4d, e). Mentum strongly enlarged (long, very thick). Glossae basally broad, narrowing toward apex, shorter than paraglossae; inner ventrolateral margin with row of long, simple setae and close to inner margin with row of very long, simple setae; apically with some very robust, long, curved setae. Paraglossae broad, slightly curved inward, with convex outer margin; apically with three rows of long,

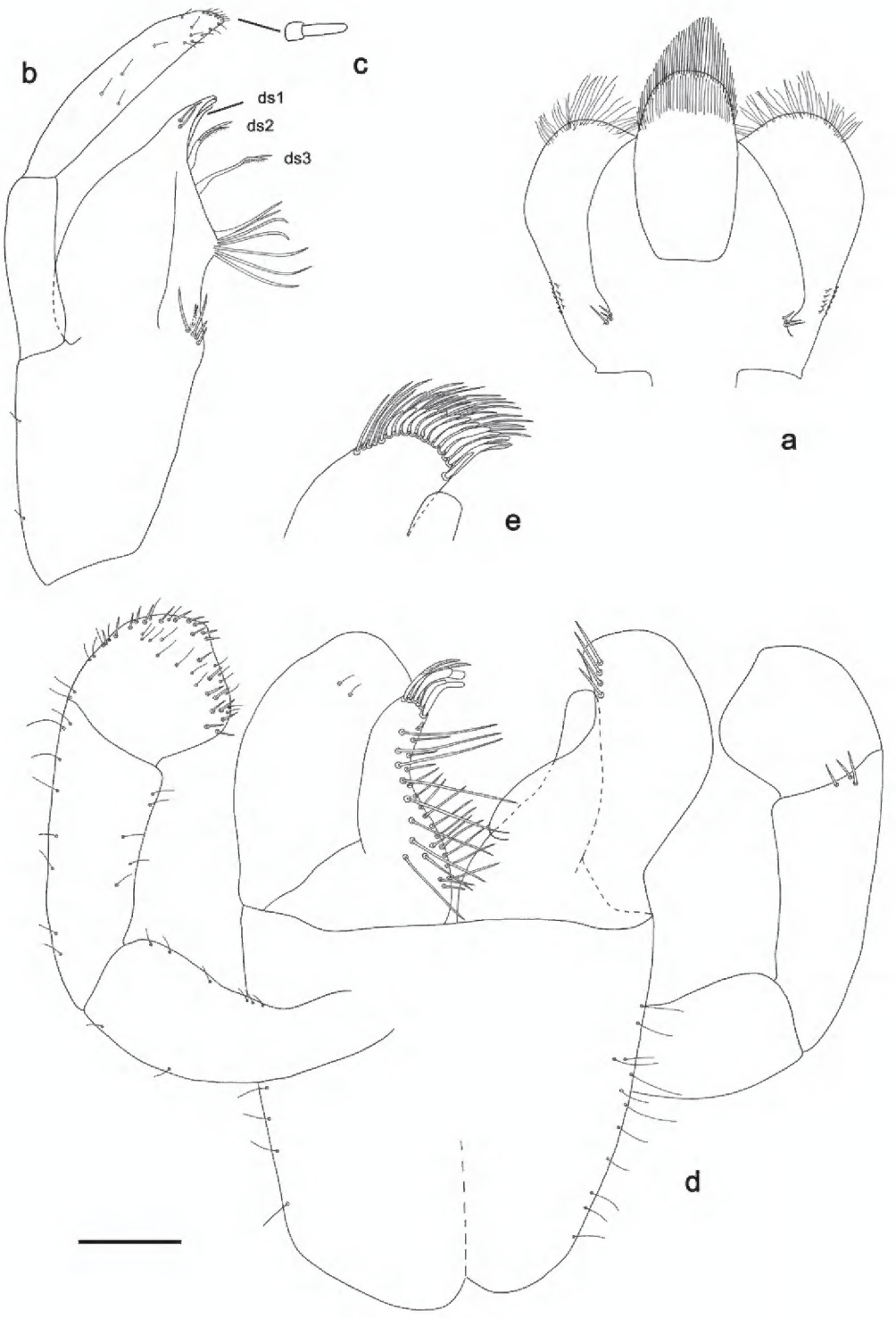

Figure 4. *Megalabiops madagasikara* gen. et sp. nov., nymph morphology **a** hypopharynx and superlinguae **b** maxilla (ds: denti-seta) **c** seta at tip of maxilla **d** labium (left: ventral view, right: dorsal view) **e** apex of paraglossa (ventral view). Scale bar: 0.1 mm.

stout, pectinate setae. Labial palps long, segment II without distolateral protuberance, segment III almost pentagonal, distal margin straight, lateral margin curved.

Thorax. ***Hind protoptera*** well developed.

Foreleg (Fig. 5a, b). ***Femur*** stocky with a row of long, spine-like setae on dorsal margin and many long, spine-like setae along ventral margin; femoral patch absent. ***Tibia*** stocky, slightly shorter than tarsus. Patellotibial suture absent, connection between tibia and tarsus tight. ***Claw*** strongly elongated, pointed; with two long rows of numerous, minute denticles; subapical setae absent.

Middle and hind legs (Fig. 5c). ***Femur*** slenderer than at foreleg; femoral patch absent. ***Tibia.*** Patellotibial suture present. ***Claw*** as in foreleg.

Abdomen. ***Tergites*** (Fig. 6a). Posterior margin with triangular spines on all segments; lateral margins without spines.

Gills (Fig. 6c). Seven pairs of gills on segments I–VII, dorsally oriented.

Paraproct (Fig. 6b). With slight, rounded expansion at posterior margin; with numerous, stout, marginal spines.

Caudal filaments (Fig. 1). Inner margin of cerci with 3 to more than 15 long, thin primary swimming setae per segment, increasing in number distally; paracercus bilaterally with 4 to more than 13 long, thin primary swimming setae per segment, increasing in number distally.

Description. Imagines. Unknown.

Distribution. (Fig. 7). Madagascar: Eastern coast.

Megalabiops madagasikara gen. et sp. nov.

http://zoobank.org/242BCFC1-6872-40F3-B85E-2ED9F77BC685

Figures 1–7

Diagnosis. Nymph. See genus diagnosis. Otherwise, if more species are discovered, specific differences in shape of labial and maxillary palps, and in setation of the legs are expected. Species with less derived characters (setation of pedicellus, shape of mentum) may also be expected.

Etymology. Madagasikara is the Malagasy name of Madagascar.

Type-material. ***Holotype.*** Madagascar • female nymph; Bas. Rianila, Riv. Affluent non nommé, Loc. Camp: route vers Lakato; 19°03'30"S, 48°21'50"E; 25.04.2003; leg. Mission MZL and M. Monaghan; on slides; GBIFCH00592692, GBIFCH00592693, GBIFCH00592728; GenBank OK510778; MZL. ***Paratype.*** Madagascar • nymph; Andasibe National Park, Antanambotsira; 18°56'09"S, 48°24'52"E; 30.11.2001; on slide; GBIFCH00592729; leg. R. Oliarinony; MZL.

Description. Nymph. (Figs 1–6). ***Body length*** ca. 4.5 mm. ***Cerci*** broken, but longer than paracercus; ***paracercus*** ca. ½ body length.

Colouration (Fig. 1 a–d). Head, thorax and abdomen dorsally light brown, without visible pattern, fore protoptera light brown. Head, thorax and abdomen ventrally light brown. Legs and caudalii light brown.

Head. ***Antenna*** (Fig. 3a). Pedicellus covered with many long, stout, slightly lanceolate, pointed setae; scapus bare.

Labrum (Fig. 3b). Lateral margins straight, distal margin largely V-shaped, length 0.8× maximum width. Distal margin with small, square process. Dorsal surface scattered with long, fine, simple setae; on each side long, pointed, submedian seta and submarginal arc restricted to two long, pointed setae. Ventrally with distal, marginal row of long, simple setae. Ventral surface with ca. two short, spine-like setae near lateral margin.

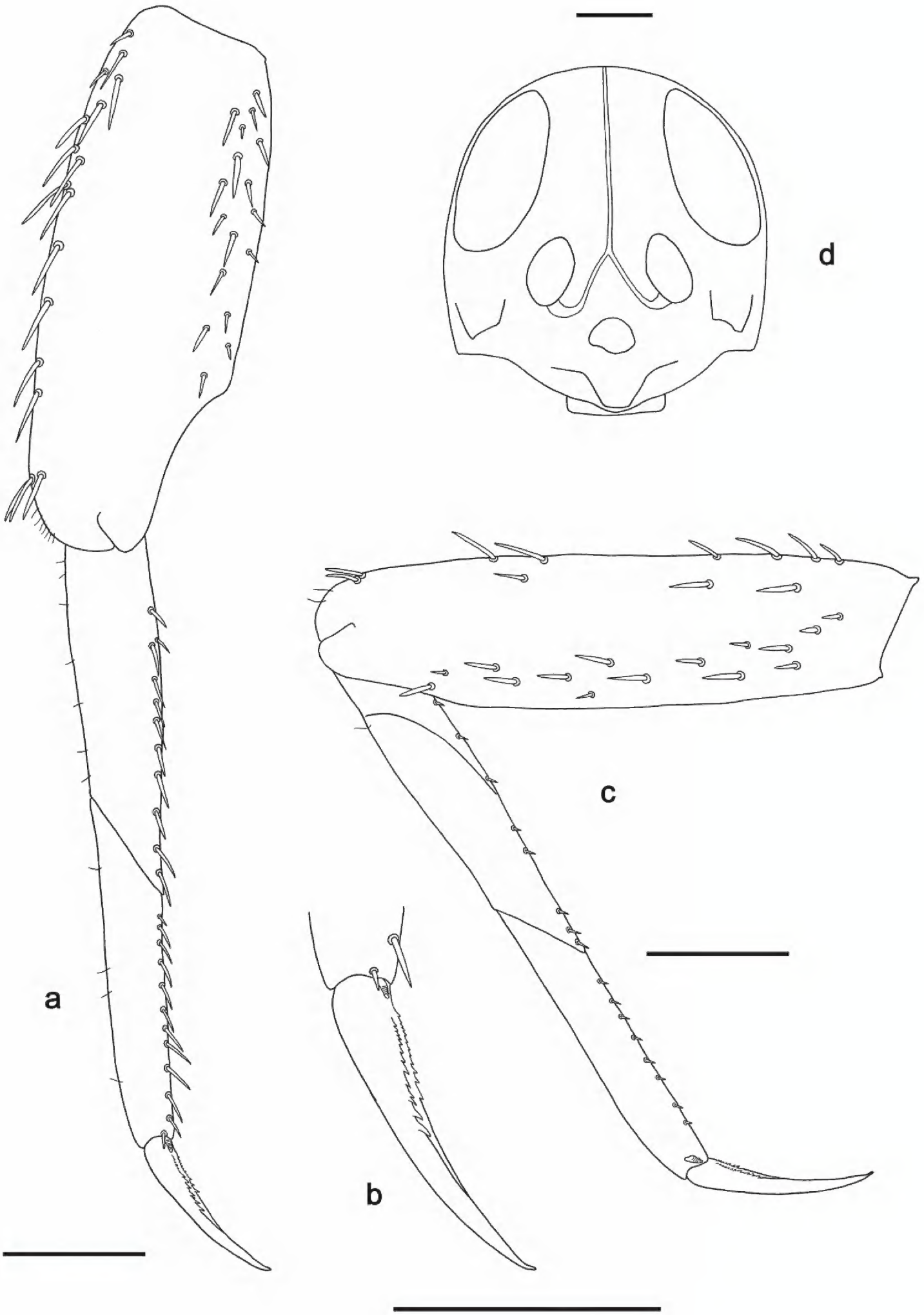

Figure 5. *Megalabiops madagasikara* gen. et sp. nov., nymph morphology **a** foreleg **b** fore claw **c** hind leg **d** head. Scale bars: 0.2 mm.

Right mandible (Fig. 3c–e). Incisor and kinetodontium cleft. Incisor with two denticles, outer denticle blade-like; kinetodontium with three denticles. Prostheca stick-like, apicolaterally denticulate. Margin between prostheca and mola straight; with brush of medium setae between prostheca and mola, length of setae ca. 1/4 of prostheca length. Tuft of setae present at apex of mola.

Left mandible (Fig. 3f–h). Incisor and kinetodontium partially cleft. Incisor with two denticles, outer denticle blade-like; kinetodontium with three denticles. Prostheca robust, apically denticulate and with comb-shape structure. Margin between prostheca and mola straight; with brush of medium setae between prostheca and mola, length of setae ca. 1/4 of prostheca length; and with minute denticles toward subtriangular process. Subtriangular process long and slender, above level of area between prostheca and mola. Tuft of setae at apex of mola absent.

Both mandibles with lateral margins convex. Basal half laterally with short, fine, simple setae.

Hypopharynx and superlinguae (Fig. 4a). Lingua longer than wide and longer than superlinguae, with prominent central protuberance; with large medial tuft of stout setae. Superlinguae distally rounded, lateral margins rounded; long, fine, simple setae along distal margin.

Maxilla (Fig. 4b, c). Galea-lacinia ventrally with two simple, apical setae under canines. Medially with one bifurcate seta and four medium, simple setae. Maxillary palp ca. 1.4× as long as length of galea-lacinia; palp segment II 1.4× length of segment I; short, fine, simple setae scattered over surface of segment II; apex pointed and with short, stout seta at tip.

Labium (Figs 2b–d, 4d, e). Inner margin of glossa with marginal row of long, simple setae, on ventral surface row of very long, simple setae close to margin; apex with four long, very robust setae, curved toward inner side, and two equally long, spine-like, pectinate setae; outer margin bare. Paraglossa with outer margin and apex convex and inner margin concave, curved inward; ventrally with three rows of long, robust, pectinate setae in apical area and two short, fine, simple setae in anteromedial area; dorsally with row of four long, spine-like setae near inner margin. Mentum strongly enlarged (extended and thickened), especially on ventral side; laterally with medium, fine, simple setae. Labial palp very long, with segment I 0.9× length of segments II and III combined. Segment I ventrally with short, fine, simple setae. Segment II elongated, conical, without protuberance; ventral surface with short, fine, simple setae; dorsally with three spine-like setae near distal margin. Segment III slightly pentagonal; length subequal to width; ventrally covered with short, spine-like setae and short, fine, simple setae.

Thorax. ***Hind protoptera*** well developed.

Foreleg (Fig. 5a, b). Ratio of foreleg segments 1.8: 1.0: 1.1: 0.6. ***Femur.*** Rather broad, length 2.7× maximum width; dorsal margin with ca. nine long, spine-like setae plus ca. five long, spine-like setae close to margin in basal part, length of setae ca. 0.3× maximum width of femur; on apex three long, spine-like setae and some

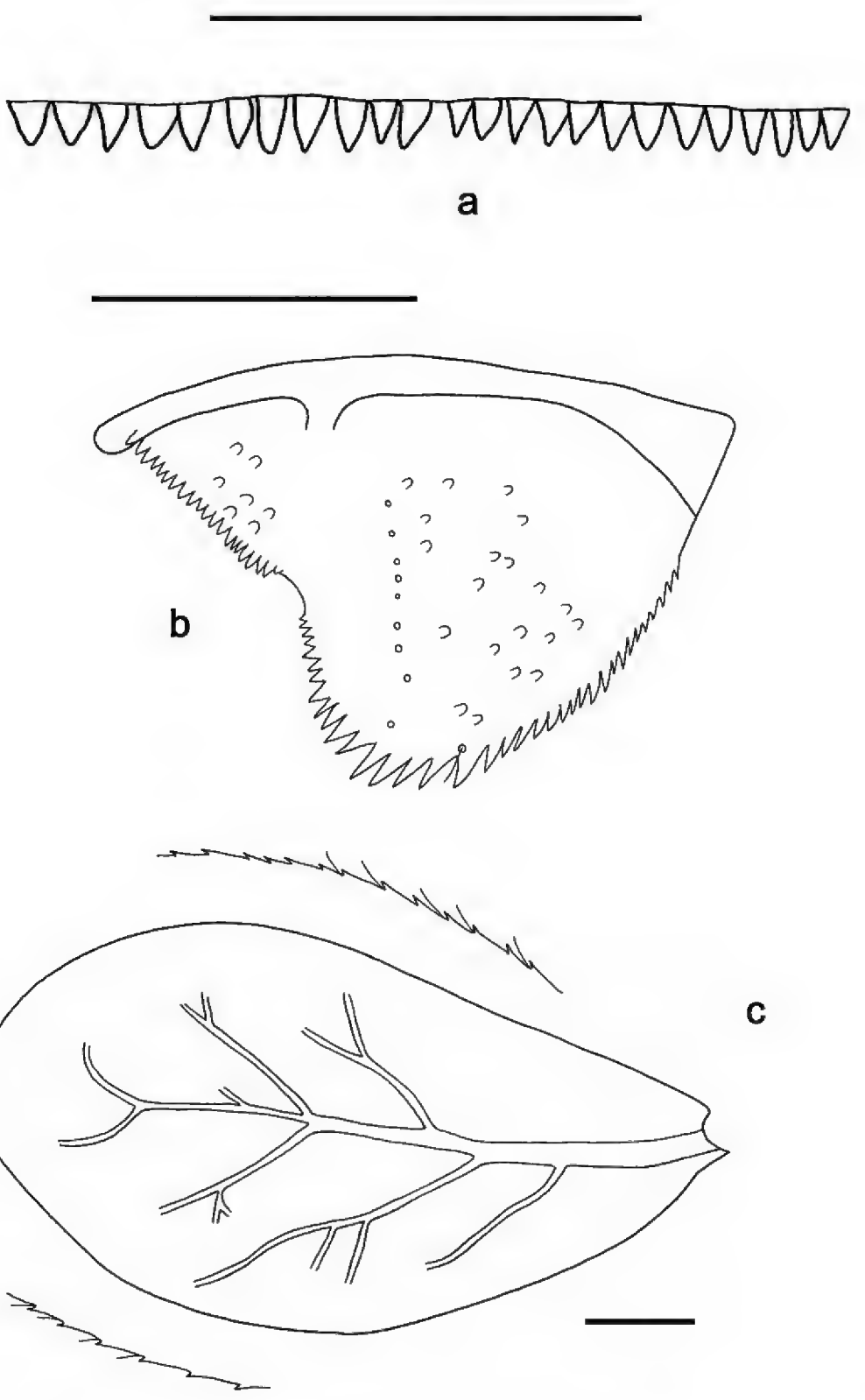

Figure 6. *Megalabiops madagasikara* gen. et sp. nov., nymph morphology **a** tergite IV (posterior margin) **b** paraproct **c** gill IV (with enlarged margins). Scale bar: 0.1 mm.

short, fine, simple setae; many short to medium, stout setae along ventral margin; femoral patch absent. ***Tibia.*** Stocky, slightly shorter than tarsus; dorsal margin with row of short, fine, simple setae; ventral margin with row of medium, curved, spine-like setae; patellotibial suture absent; connection to tarsus tight. ***Tarsus.*** Dorsal margin with row of scarce, short, fine, simple setae; ventral margin with row of short to medium, curved, spine-like setae. ***Claw*** strongly elongated, distally pointed, with two rows of numerous minute denticles; denticles decreasing in size distally; subapical setae absent.

Figure 7. *Megalabiops madagasikara* gen. et sp. nov., distribution in Madagascar.

Middle leg. Ratio of middle leg segments 1.7: 1.0: 1.0: 0.5. ***Femur.*** Length 3.4× maximum width. With similar setation as foreleg; femoral patch absent. ***Tibia*** as hind leg; dorsal margin almost bare; ventral margin with row of short, spine-like setae. Patellotibial suture present on basal 1/3 area. ***Tarsus*** as hind leg; dorsal margin bare; ventral margin with row of short, spine-like setae. ***Claw*** as foreleg.

Hind leg (Fig. 5c). Ratio of hind leg segments 1.8: 1.0: 1.0: 0.6. ***Femur.*** Length 4× maximum width. Dorsal margin with ca. six long, spine-like setae plus ca. three long, spine-like setae close to margin; many short to medium, stout setae along ventral margin; femoral patch absent. ***Tibia.*** Dorsal margin almost bare; ventral margin with a row of short, spine-like setae. Patellotibial suture present on basal 1/3 area. ***Tarsus.*** Dorsal margin bare; ventral margin with a row of short, spine-like setae. ***Claw*** as foreleg.

Abdomen. ***Tergites*** (Fig. 6a). Posterior margin of tergites with triangular spines, longer than wide.

Gills (Fig. 6c). Gills on segments I–VII. Costal and anal margins with small denticles intercalating short, fine, simple setae. Tracheae extending from main trunk to inner and outer margins. Gill I as long as 1/3 length of segment II; gill IV as long as length of segments V, VI and 1/3 VII combined; gill VII reaching end of segment X.

Paraproct (Fig. 6b). Posterior margin slightly expanded; with ca. 36 stout, marginal spines. Surface scattered with U-shaped scale bases, some fine, simple setae and micropores. Cercotractor with small, marginal spines.

Distribution. (Fig. 7). Madagascar: Eastern coast.

Biology. Larvae were collected in two pristine streams running in relatively preserved natural tropical rain forests. Environmental parameters of the type-locality: width 2–3m, depth 0.1–0.2m, velocity 0.6–0.8 m/s, temperature 16–18 °C. The riverbed was a mix of sand, gravel and rocks with a few small waterfalls and very limited riparian vegetation. Mayfly fauna is very diversified with around twenty species of Baetidae, including four carnivorous species (*Nesoptiloides electroptera* (Demoulin, 1966), *Herbrossus christinae* Gattolliat & Sartori, 1998, *Herbrossus edmundsorum* McCafferty & Lugo-Ortiz, 1998, and *Guloptiloides gargantua* Gattolliat & Sartori, 2000), scrapers (*Dicentroptilum merina* Lugo-Ortiz & McCafferty, 1998, *Xyrodromeus* spp.), and species adapted to fast flow (*Afroptiloides delphinae* Gattolliat, 2000). Besides Baetidae, Caenidae and Tricorythidae were the most abundant families; larvae of the huge borrowing mayfly, *Proboscidoplocia* sp. (Euthyplociidae), were also collected in abundance. Both larvae were still in middle instar in April (end of rainy season) and November (beginning of rainy season); we hypothesize that *Megalabiops madagasikara* sp. nov has a long flight period as most of the Malagasy species of Baetidae.

Discussion

Megalabiops gen. nov. clearly belongs to the family Baetidae based on the pisciform body shape (Fig. 1); the nymphal Y-shaped frontal suture reaching ventrally to lateral ocelli (Fig. 5d); the labrum with distinctly expressed median incision (Fig. 3b); the shape of the right and left prostheca (Fig. 3d, g); the shape of the glossae (basally widened, most part narrow) (Fig. 4d); and the anterior outer projection of the femur apex, which is directed toward the inner side of the femur (Fig. 5a, c) (Wang and McCafferty 1996; Kluge 2004). The new genus can be assigned to the Protopatellata Kluge & Novikova, 2011 according to the rank free system of Kluge (Kluge 1997; Kluge and Novikova 2011), based on the absence of a patellotibial suture in the foreleg and its presence in middle and hind legs of the nymph.

African genera of Protopatellata were previously assigned either to the *Centroptiloides* complex (Lugo-Ortiz and McCafferty 1998a) corresponding to Centroptiloides/g2 in Kluge's rank free system, or to the *Bugilliesia* complex (Lugo-Ortiz & McCafferty 1996; Gattolliat 2006; Kluge 2012) corresponding to the Rhithrocloeoninae or Rhithrocloeon/fg1 in Kluge's rank free system. The *Centroptiloides* complex also includes highly adapted taxa such as the carnivorous genera *Nesoptiloides* Demoulin, 1973 or *Barnumus* McCafferty & Lugo-Ortiz, 1998. Most genera of this complex have the right incisor and kinetodontium only partially fused, patch of setae between

prostheca and mola of the right mandible and the claws with two rows of denticles increasing in size progressively (Lugo-Ortiz and McCafferty 1998a). The *Bugilliesia* complex is mainly defined at the imaginal stage by the highly modified 2-segmented forceps (Lugo-Ortiz and McCafferty 1996; Kluge 2012).

The following characters differentiate *Megalabiops* gen. nov. from all other genera of Protopatellata and even of Baetidae in general: antennae with many long, slightly lanceolate setae on pedicelli (Fig. 3a); labium with mentum strongly enlarged (extended and thickened, especially on ventral side), laterally with fine, simple setae (Figs 2b–d, 4d); glossae ventrally with one row of very long setae close to margin and one row of long setae on margin (Fig. 4d).

Pedicelliops Kaltenbach & Gattolliat, 2020, another genus of Protopatellata, also has two rows of setae of different length ventrally on and close to the margin of the glossae and similar stout, curved setae at their apex (Kaltenbach and Gattolliat 2020b: fig. 4i). Further, it also has a carina between the antennae, a similar shape of the mandibles (outer lateral margins convex) and a brush of setae between prostheca and mola of both mandibles (Kaltenbach and Gattolliat 2020b: figs 2d, 4b, d). However, the other mouthparts are dissimilar, the legs are strongly adapted with long setae at the femur and the pedicellus is bilaterally strongly enlarged (Kaltenbach and Gattolliat 2020b: figs 4, 5a, c, 3a). From the illustrations, it appears that also *Micksiops bicaudatus* (Gillies, 1990) has glossae with shorter and longer setae on ventral side (Gillies 1990: fig. 91), but other mouthparts and legs are dissimilar to *Megalabiops* gen. nov.

Elongated claws with two rows of numerous denticles increasing in length toward the apex are also typical for species of *Bugilliesia* Lugo-Ortiz & McCafferty, 1996. However, the legs are generally very slender and there is no tight connection between tibia and tarsus. Additionally, the maxillary palp has a small third segment, the glossae are without rows of long setae, the labial palp segment II has a distomedial protuberance, and the submarginal arc of setae on dorsal surface of the labrum is composed of lanceolate setae (Gattolliat et al. 2009).

The legs of *Megalabiops* gen. nov. are similar to *Delouardus djabala* Lugo-Ortiz & McCafferty, 1999: the tibia is slightly shorter than the tarsus, with a tight connection between them; the claws are elongated with two rows of denticles; and the setation is similar. Further, there are some long, simple setae on the pedicellus (but not stout, slightly lanceolate setae as in *Megalabiops* gen. nov.) and both mandibles have a brush of fine, simple setae between prostheca and mola. The claws of *Megalabiops* gen. nov. and the tight connection between tibia and tarsus are also similar to *Cheleocloeon* Wuillot & Gillies, 1993. However, *Delouardus* and *Cheleocloeon* are different in other characters from *Megalabiops* gen. nov., e.g. the labium without long setae on the glossae and the labial palp segment II with a large distomedial protuberance. The sister genera *Delouardus* and *Cheleocloeon* belong to the Anteropatellata according to the rank free system of Kluge (Kluge and Novikova 2011), with a patellotibial suture on all legs of the nymph.

The labrum with straight lateral margins and a largely V-shaped distal margin is also rather unusual among Baetidae. All other genera presenting a similar labrum (*Cal-*

libaetis Eaton, 1881; *Callibaetoides* Cruz, Salles & Hamada, 2013; *Demoulinia* Gillies, 1990; *Waltzoyphius* Lugo-Ortiz & McCafferty, 1995 and Australian species provisionally assigned to *Centroptilum* Eaton, 1869) have a patellotibial suture on all legs of the nymph, belonging to the Anteropatellata (Suter 1986; Gattolliat 2003; Webb and Suter 2011; Cruz et al. 2013, 2017; Kluge 2020).

A remarkable setation on the antennal base is also present in two Neotropical Anteropatellata: *Rivudiva trichobasis* Lugo-Ortiz & McCafferty, 1998 has many long, robust, simple setae on scape and pedicellus and *Spiritiops silvudus* Lugo-Ortiz & McCafferty, 1998 has many minute, fine, simple setae scattered over surface of scape and pedicellus (Lugo-Ortiz and McCafferty 1998b).

As a conclusion, the relationship of *Megalabiops* gen. nov. with other genera remains unresolved and knowledge of the imaginal stage, especially of the male genitalia and the number of intercalary veins of the wings is of major importance to confirm the possible relationship with the *Centroptiloides* complex or Rhithrocloeoninae (sensu Kluge 2012). Indeed, *Bugilliesia* Lugo-Ortiz & McCafferty, 1996, and related genera belonging to this subfamily, possess a unique character: the loss of the last segment of the gonostylus.

The description of *Megalabiops* gen. nov. is based on only two nymphs. Remarkably, these nymphs were found in two frequently sampled localities, where different field trips of the ORSTOM and MZL teams (Elouard and Gibon 2001) as well as a monthly survey of this catchment (Oliarinony et al. 2016) were done. Intensive fieldwork and many studies were done in Madagascar by one of the authors (e.g. Gattolliat and Sartori 1998, 1999, 2000, 2001; Gattolliat 2001, 2002, 2006; Gattolliat et al. 2009), and because of its reasonable size and its ease of recognition, we cannot assume that additional material stored in our collection was overlooked. It could mean that either this species is extremely rare, or it occurs in microhabitats, which were only rarely or not at all sampled, and the two specimens were collected by chance.

The number of localities and different habitats sampled in Madagascar are relatively high, but there are still areas where no collection activities have occurred (especially in the Northeast of the island including the Masoala Peninsula). Taking into account the obvious biological richness of this island, it would be prudent to assume that the number of genera and species of Baetidae will continue to increase with further fieldwork and collections in Madagascar.

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